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# Fathers with PTSD and depression in pregnancies complicated by preterm preeclampsia or PPRM

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## Abstract

**Purpose** To assess prevalence and risk factors for post-traumatic stress disorder (PTSD) and depression in fathers after early preeclampsia (PE) or preterm premature rupture of membranes (PPROM).

**Methods** Partners of patients hospitalized for PE or PPRM and partners of healthy controls completed PTSD (PSS-SR) and depression (BDI-II) questionnaires during pregnancy ( $t_1$ ) and 6 weeks postpartum ( $t_2$ ). 85 of the 187 eligible men participated (51 partners of patients, 34 partners of control) at  $t_1$ , and 66 men participated both time points.

**Results** No significant differences were found between partners of patients and partners of controls in symptoms of PTSD and depression ( $t_1$ :  $p = 0.28$  for PTSD and  $p = 0.34$

for depression;  $t_2$ :  $p = 0.08$  for PTSD and  $p = 0.31$  for depression). For partners of patients, correlation between PTSD and depression sum-scores was 0.48 ( $p < 0.001$ ) at  $t_1$  and 0.86 ( $p < 0.001$ ) at  $t_2$ . Within-couple correlation was low and not significant during pregnancy, but strong at postpartum (PSS-SR:  $r = 0.62$ ,  $p < 0.001$ ; BDI-II:  $r = 0.59$ ,  $p < 0.001$ ). Higher paternal age was associated with more symptoms of PTSD and depression postpartum in partners of patients. Symptoms of PTSD and depression during pregnancy predicted the occurrence of PTSD symptoms following childbirth in partners of patients.

**Conclusions** Symptoms of PTSD and depression occurred at a similar rate in partners of women with PE or PPRM and partners of healthy pregnant controls. Symptoms of PTSD and depression during pregnancy predicted the occurrence of PTSD symptoms following childbirth. Increased paternal age predicted more symptoms of PTSD and depression postpartum. At 6 weeks postpartum, a strong association was found between men and women in symptoms of PTSD and depression.

This study was conducted at the University Medical Center Groningen, The Netherlands.

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**Keywords** PTSD · Depression · Fathers · Postpartum · Preeclampsia · PPRM

## Introduction

Depression affects roughly 12 % of women during pregnancy and 7 % postpartum [1], whereas posttraumatic stress disorder (PTSD) following childbirth and pregnancy occurs after 1–2 percent of deliveries [2, 3]. Next to affecting the well being of the woman, both postpartum depression (PPD) and PTSD may impair secure attachment of the infant and affect the partner relationship [4, 5]. Contrary to a commonly held belief, the birth of a child can

trigger the onset of mental problems and psychiatric illnesses in fathers as well [6], and their mental well being is known to affect the parent–child relationship, and child behavioral and emotional development [7–9].

Whether or not prevalence rates of depression are similar in men and women is under debate, as various studies find contradictory results [10–14]. A substantial amount of research has been carried out regarding postpartum depression in men, and a recent meta-analysis estimated the prevalence at 10.4 percent [15]. The strongest predictor for paternal depression is maternal postpartum depression, as it affects 24–50 % of the partners of women with postpartum depression [16].

A limited number of recent studies have investigated the occurrence of PTSD following childbirth in men. PTSD is an anxiety disorder that may develop following confrontation with a traumatic stressor, with three categories of characteristic symptoms: re-experiencing of the event, avoidance of stimuli associated with the event, and hyperarousal [17]. The DSM-IV states that in order to qualify for PTSD, a traumatic event may also be witnessed (as partners do) rather than experienced (by the pregnant woman), but the actual experience of “threat to own life” is considered a strong predictor for the development of PTSD [18]. In a retrospective study by Bradley et al. [19], 199 fathers of healthy newborns who were present during the hospital birth were assessed 6 weeks following childbirth. No men were found to have PTSD, although 12 % reported symptoms on at least one of the three PTSD symptom categories. Clinically significant symptoms of depression and anxiety were found in 8 and 7 % of fathers, respectively. Skari et al. [10] included both mothers and fathers, and found significant levels of acute distress and intrusive symptoms (DSM-IV criterion C as measured with the Impact of Events Scale (IES) [20]) during the first 4 days after delivery. Symptoms were more frequent in women than in men, but no full constellation of PTSD symptoms was found in any subject. In a study by Ayers et al. [21], 5 % of women and men scored above the recommended cut-off for both avoidance and intrusion on the IES. Even though the similar rates in men and women are not in line with other literature, it is of interest that the six cases were two couples and two individuals, suggesting a concordance between couples, as is known from studies on postpartum depression. A recent study by Iles et al. [14] found that symptoms of PTSD were significantly related within couples, and that dissatisfaction with partner support and less secure attachment were associated with higher levels of posttraumatic stress and depression postpartum.

In women, several studies showed significantly higher PTSD rates after preterm delivery (due to various causes) compared to uncomplicated pregnancies [22–30]. Only one prior study has thus far looked at PTSD in partners of

women with severe pregnancy complications. Pierrehumbert et al. [25] assessed PTSD in parents of infants born prematurely (25–33 weeks gestation). Both mothers and fathers were found to have more posttraumatic stress (symptoms) than parents of healthy infants born at term. In this retrospective study, parents were assessed 18 months after delivery. This is long, considering that the chance of other causes for PTSD increases with time, subsequent pregnancies and deliveries may have occurred in the mean time, and the longitudinal course of PTSD following childbirth is not sufficiently clear. Furthermore, the perinatal PTSD questionnaire (PPQ) used in Pierrehumbert’s study does not contain all DSM-IV criteria for PTSD, which has been noted as a point of concern [31]. In a study involving the current sample that we published recently [30], 14 % of women hospitalized for preeclampsia (PE) or preterm premature rupture of membranes (PPROM) fulfilled the DSM-IV criteria for PTSD on the *PTSD Symptom Scale self-report questionnaire* (PSS-SR) [32] at 6-week postpartum, and 11 % were at least moderately depressed based on the *Beck Depression Inventory, second edition* (BDI-II) [33]. These data, as well as the identified risk factors for women (history of depression, depressive symptoms during pregnancy, perinatal mortality) made us inquire into the mental well-being of partners of women with pregnancy complications.

The present study included three main research questions with corresponding hypotheses: (1) What is the occurrence of symptoms of PTSD and depression during pregnancy and postpartum, in partners of women with complicated pregnancies, as compared to partners of women with uneventful pregnancies. Based on the findings of our study of women with PE/PPROM and healthy pregnant controls [30], we hypothesized that partners of patients would report more symptoms of PTSD and depression than partners of controls; (2) Is there a relation between symptoms of PTSD and depression in women and men? We hypothesized a moderate to strong correlation between partners, both during pregnancy and postpartum; (3) Which factors predict the occurrence of symptoms of PTSD and depression in partners of patients at 6 weeks postpartum? Based on previous studies conducted among women, we hypothesized that demographic factors would not be related to psychiatric symptoms, but obstetric factors and symptoms of PTSD and depression during pregnancy would predict the occurrence of symptoms in men postpartum.

## Methods

### Design and setting

In this longitudinal study, pregnant women with PE or HELLP syndrome (hemolysis, elevated liver enzymes, low

platelets), and women with PPROM took part. PE was defined according to the American Congress of Obstetricians and Gynecologists' (ACOG) practice bulletin on preeclampsia and eclampsia [34]: a systolic blood pressure of 140 mm Hg or more, or a diastolic blood pressure of 90 mm Hg or more, in a previously normotensive woman after 20 weeks gestation, combined with the presence of 0.3 g or more of protein in a 24-h urine specimen [35]. HELLP syndrome was defined as aspartate aminotransferase (AST) and/or alanine aminotransferase (ALT) > 50 IU/L, and platelets  $<100 \times 10^9/L$ , and lactate dehydrogenase >600 IU/L. Preterm premature rupture of membranes (PPROM) was defined according to the ACOG practice bulletin on PROM [36]: rupture of membranes prior to the onset of labor and before 37 weeks of gestation. The female patients were recruited in the obstetric clinic of a University hospital in The Netherlands during a 3-year period. Healthy female controls with uneventful pregnancies were recruited in a community midwifery practice by means of posters announcing the study. Results of the mothers (patients and controls) have been published previously [30].

### Population

All women hospitalized for PE and PPROM were asked to participate in the study, unless their condition was so critical (as assessed by the clinician admitting them) that (a) they needed an immediate cesarean section, (b) they received magnesium sulfate treatment, or (c) they were too ill to complete questionnaires. Additional exclusion criteria were current multiple pregnancy, a history of intrauterine fetal death, and current alcohol or drugs dependence (of the pregnant woman). Furthermore, women with pre-existing medical conditions (diabetes mellitus, hypertension, cardiovascular or renal diseases, systemic lupus erythematosus) were excluded, as these women would be likely to anticipate pregnancy complications due to their pre-existing condition. Partners of patients and partners of controls were invited to take part in the study, though women could also take part if their partner refused. No further exclusion criteria were applied for the partners. Participants had to be fluent in Dutch and give written informed consent. Approval was obtained from the Medical Ethics Committee (Institutional Review Board) of the University Medical Center.

### Procedure

Upon admission, patients and their partners were informed about the study and were asked to consider their participation within 24 h. Female controls and their partners could sign up for the study through their community

midwife. Following signed informed consent, they were contacted by one of the researchers and asked to complete questionnaires as soon as possible in order to minimize the loss of participants due to delivery before testing. Participants were tested during pregnancy ( $t_1$ ) and 6 weeks postpartum ( $t_2$ ). In order to obtain comparable intervals between  $t_1$  and  $t_2$  in the patient and control groups, female controls and their partners were tested in the 38th week of pregnancy.

### Measures

At  $t_1$ , all participants (male and female) completed a brief self-report measure of general demographic information, and answered questions about previous psychiatric history: (a) whether they had ever had "one or more periods of feeling depressed or down for most of the day, during which they were not interested in activities that they enjoyed before", indicating depressive symptoms; (b) whether they had "ever experienced something traumatic" (incl. some examples) and "whether this influenced them afterwards, for example through nightmares or flashbacks", indicating posttraumatic stress symptoms. Data regarding current and past obstetric status were collected from the medical record of the female patients and controls.

During both test-sessions, the PTSD Symptom Scale self-report questionnaire (PSS-SR) [32] and the Beck Depression Inventory, second edition (BDI-II) [33], were completed. The PSS-SR is a frequently used self-report measure of PTSD symptoms. The questionnaire contains 17 items corresponding to the 17 PTSD symptoms described in the DSM-IV (criteria B, C and D). These items are rated using 4-point scales asking for the occurrence of each symptom over the past month (0 = never/not at all, 1 = once a week/a little bit, 2 = two to four times a week/somewhat, 3 = more than five times a week/very much). Symptoms were considered present if an item was rated 2 or 3. The PSS-SR sum-score ranges from 0 to 51. The PSS-SR that was administered at  $t_1$  asked for PTSD symptoms in the preceding month that were related to any stressful event experienced before that still bothered the participants. At  $t_2$ , the PSS-SR referred to PTSD symptoms in the preceding month that were specifically related to pregnancy and the perinatal period. In addition, at  $t_2$ , the participants rated the extent to which they had felt fear, helplessness, or horror during the pregnancy-related event they experienced as most shocking on three 100 mm (3.9 inch) Visual Analogue Scales (VAS). Using visual analogue scales is a reliable method to assess pain, anxiety and mood disorders that is frequently used in both research and hospital settings [37–39]. The 100 mm strip depicts a linear continuum from experiencing no pain or a certain emotion (0), to

experiencing the worst imaginable pain or most intense emotion (100). Recent research concludes that VAS scales approximate an interval-scale level, and therefore have superior psychometric properties as compared to ordinal-scale categorical measures such as Likert scales [40]. In the present study, PTSD diagnosis at  $t_2$  was based on a symptom profile reflected by the PSS-SR and VAS scores that were consistent with the DSM-IV criteria. For this, we used the criteria as used in the study by Engelhard et al. [22]. More specifically, pregnancy-related PTSD was considered present when participants (a) scored 80 or more on one of the VAS for horror, fear, and/or helplessness at  $t_2$  (subjective stress, DSM-IV A2 criterion); (b) reported at least one re-experiencing, three avoidance, and two hyperarousal symptoms on the PSS (DSM-IV, B, C, and D criterion, respectively); (c) obtained a total PSS-SR score of 18 or higher (severity, DSM-IV F criterion). It should be noted that the duration criterion of 4 weeks (DSM-IV E criterion) was met because follow-up assessment was at 6 weeks and postpartum. The test–retest reliability has been calculated  $\alpha = 0.74$  [32]. The PSS-SR has been validated in the Netherlands in a non-pregnant population, with  $\alpha = 0.93$ , sensitivity between 0.80 and 0.90, and specificity between 0.84 and 0.88 [41]. The BDI-II [33] is a self-report measure of depressive symptoms during the preceding 2 weeks. It consists of 21 items containing four statements that reflect increasing symptom severity (scoring 0–3 per item). The sum-score ranges from 0 to 63. A cut-off score of 20 or more was used, corresponding with moderate depression according to the BDI manual [33]. The BDI-II is one of the most frequently used depression instruments in clinical psychological settings, and found to have good psychometric properties in both clinical samples and the general population [33, 42–44]. The Dutch version has been validated in non-pregnant patient groups [45, 46]. As opposed to some other depression questionnaires, the BDI includes all DSM-IV symptom criteria, and allows for differentiation between somatic and non-somatic symptoms.

### Statistical analysis

Data were analyzed with SPSS 16.0, using a significance level of .05 (two-tailed). For the dichotomous data,  $\chi^2$  analyses were used. Exploration of the continuous data revealed that the PSS and BDI sum-scores were not normally distributed. Therefore, non-parametrical Spearman's rho, Kruskal–Wallis and Mann–Whitney  $U$  tests were used. In order to identify risk factors for PTSD and depression at  $t_2$ , stepwise multiple regression analyses (SMRA) were performed on the PSS and BDI sum-scores. Where appropriate, non-normally distributed variables were

square root transformed (SQRT) to meet assumptions of normality, linearity, and homoscedasticity. Due to the relatively small sample size (and therefore low number of variables desired in the SMRA), we only included variables with a  $p$  value lower than 0.05 as found in univariate analyses in the SMRA. In order to evaluate the contribution of mental well being of female patients and their partners at  $t_2$  to the PSS-SR and BDI scores, a stepwise model was created, entering factors known at  $t_1$  in the first step, followed by factors known at  $t_2$  in the second step. Two sets of variables showed multicollinearity: PSS-SR and BDI scores at  $t_2$  in partners of patients, and PSS-SR and BDI scores at  $t_2$  in female patients. Therefore, the PSS-SR scores of female patients and partners of patients at  $t_2$  were excluded from the depression model and similarly, the BDI scores of female patients and partners of patients at  $t_2$  were excluded from the PTSD model.

## Results

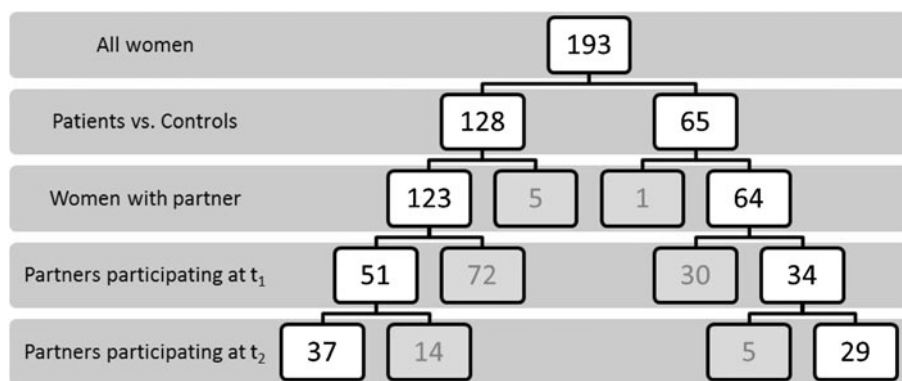
### Patient characteristics

At  $t_1$ , 193 females (patients and controls) were included in the study, of whom 6 did not have a partner. Of the 187 eligible partners (all male), 85 agreed to participate at  $t_1$  (45 %). Non-responder analysis (using  $t$  tests, Chi square and Fisher's exact tests) demonstrated that women whose partners did and did not participate were comparable for demographic factors (age, education, marital status), obstetric factors (primiparity, cesarean rate, gestational age at delivery, perinatal mortality) and symptoms of PTSD and depression in history, at  $t_1$  and at  $t_2$ .

At  $t_2$ , 66 men completed questionnaires, whereas 19 men declined further participation (see Fig. 1). No significant differences were found between partners of controls participating at both  $t_1$  and  $t_2$  versus partners of controls only participating at  $t_1$ . Between partners of patients participating at both  $t_1$  and  $t_2$  versus those only participating at  $t_1$ , the only significant difference was that the 37 full participants reported fewer PTSD symptoms at  $t_1$  than the 14 men who dropped out after  $t_1$  ( $p = 0.021$ ). In absolute numbers, the three partners of patients with PTSD during pregnancy and the two partners of patients with depression during pregnancy did not participate at  $t_2$ . No differences were found in demographic, obstetric and psychological characteristics between men whose partner had PE and men whose partner was hospitalized with PPRM, except that primiparity and cesarean section were more common among women with PE than PPRM. Further analyses have therefore been performed with the two groups combined. Demographic and obstetric characteristics of the 66



**Fig. 1** Overview of participation and dropout ( $n$ ).  $t_1$  During pregnancy,  $t_2$  6 weeks postpartum



**Table 1** Characteristics of partners participating at  $t_2$  ( $n = 66$ )

	Partners of patients ( $n = 37$ )	Partners of controls ( $n = 29$ )
<i>Demographics</i>		
Age		
Mean (SD)	31 (5.3)	34 (3.5)*
Higher education		
% (N/total)	33 (12/36)	90 (26/29)*
Employed		
% (N/total)	100 (35/35)	97 (28/29)
<i>Psychiatric history</i>		
Reported history of depression		
% (N/total)	25 (9/36)	35 (10/29)
Reported history of PTSD		
% (N/total)	14 (5/36)	24 (7/29)
Previous treatment for psychiatric problems		
% (N/total)	11 (4/37)	24 (7/29)
Current treatment for psychiatric problems		
% (N/total)	0 (0/37)	17 (5/29)*
<i>Obstetric characteristics (females)</i>		
Primipara		
% (N/total)	64 (23/36)	72 (21/29)
Cesarean section		
% (N/total)	59 (22/37)	3 (1/29)*
Gestational age (weeks)		
Mean (SD)	31 + 6 (3 + 2)	40 + 5 (0 + 6)*
Infant death		
% (N/total)	8 (3/37)	0 (0/29)

Demographics and psychiatric history collected at  $t_1$ , obstetric characteristics collected at  $t_2$

\*  $p \leq 0.05$

men participating at  $t_2$ , including differences between partners of patients and partners of controls, are shown in Table 1.

### Prevalence of symptoms of PTSD and depression

No significant differences were found between partners of patients and partners of controls in symptoms of PTSD and depression. At  $t_1$ , the mean sum-score on the 17 PSS-SR items was 6.9 for partners of patients and 4.6 for partners of controls ( $p = 0.28$ ), and the mean sum-score on the 21 BDI-II items was 7.0 for partners of patients and 5.6 for partners of controls ( $p = 0.34$ ); at  $t_2$ , the mean sum-score on the 17 PSS-SR items was 6.5 for partners of patients and 3.1 for partners of controls ( $p = 0.08$ ), and the mean sum-score on the 21 BDI-II items was 5.6 for partners of patients and 3.9 for partners of controls ( $p = 0.31$ ). In partners of patients, the correlation between PTSD and depression sum-scores was 0.48 ( $p < 0.001$ ) during pregnancy, and 0.86 ( $p < 0.001$ ) postpartum. For partners of controls, the correlation between PTSD and depression sum-scores was 0.60 ( $p < 0.001$ ) during pregnancy, and 0.73 ( $p < 0.001$ ) postpartum. No men met the DSM-IV criteria for both disorders simultaneously.

### Relation between paternal and maternal symptoms

Within-couple correlation of PTSD and depression symptom severity was low and not significant during pregnancy (PSS-SR:  $r = 0.24$ ,  $p = 0.159$ ; BDI-II:  $r = 0.17$ ,  $p = 0.303$ ), but strong postpartum (PSS-SR:  $r = 0.62$ ,  $p < 0.001$ ; BDI-II:  $r = 0.59$ ,  $p < 0.001$ ).

Tables 2 and 3 display the associations between symptoms of PTSD/depression in partners of patients at  $t_2$  and several demographic, obstetric and psychiatric factors. In partners of patients, PTSD and depressive symptoms postpartum ( $t_2$ ) were associated with PTSD and depression at  $t_1$ , with concurrent PTSD and depression (at  $t_2$ ) in their female partners, but not with a history of depression or PTSD in either female patients or their partners. Furthermore, lower gestational age at delivery, infant death and

**Table 2** Spearman's Rho correlations between PTSD/depressive symptoms and demographic, obstetric and psychiatric characteristics for partners of patients participating at  $t_2$  ( $n = 37$ )

	PTSD symptoms		Depressive symptoms	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
<i>Demographic and obstetric variables</i>				
Age	0.376	0.026*	0.367	0.030*
Gestational age (weeks)	−0.471	0.003**	−0.423	0.009**
<i>Psychiatric history (partners of patients)</i>				
PTSD symptoms $t_1$	0.456	0.005**	0.411	0.012*
Depressive symptoms $t_1$	0.558	<0.001***	0.671	<0.001***
PTSD symptoms $t_2$	–	–	0.858	<0.001***
Depressive symptoms $t_2$	0.858	<0.001***	–	–
<i>Psychiatric history (female patients)</i>				
PTSD symptoms $t_1$	0.357	0.030*	0.179	0.289
Depressive symptoms $t_1$	0.149	0.378	0.075	0.657
PTSD symptoms $t_2$	0.624	<0.001***	0.531	<0.001***
Depressive symptoms $t_2$	0.625	<0.001***	0.586	<0.001***

\* Significant at  $p = 0.05$  level\*\* Significant at  $p = 0.01$  level\*\*\* Significant at  $p < 0.001$  level

higher paternal age were associated with more symptoms of PTSD and depression at  $t_2$ , whereas parity and mode of delivery were unrelated to PTSD/depression postpartum in partners of patients.

#### Evaluation of possible risk factors

Finally, we evaluated the partners of patients for the contribution of risk factors to the PSS-SR and BDI scores at  $t_2$  using two stepwise multiple regression analyses (SMRA). All variables with a  $p$  value of 0.05 or lower in the univariate analyses (Table 3) were included.

Table 4 shows the SMRA for PTSD symptoms (PSS-SR sum-scores) of partners of patients at  $t_2$ . The model for SQRT PSS-SR at  $t_2$  explained 53 % (adjusted  $R^2$ ) of the variance in the PSS-SR sum-scores in the first step (Sig.  $F$  change < 0.001), while the second step was not significant (sig.  $F$  change = 0.074). Significant predictors of high paternal PSS-SR sum-scores at  $t_2$  were PSS-SR and BDI sum-scores in men at  $t_1$  and higher paternal age (Table 4).

Table 5 shows the SMRA for depressive symptoms (BDI-II sum-scores) of partners of patients at  $t_2$ . The model for SQRT BDI explained 55 % (adjusted  $R^2$ ) of the variance in BDI sum-scores in the first step (Sig.  $F$  change < 0.001) and an additional 9.7 % in step 2 (Sig.  $F$  change = 0.023). The only significant predictor of high BDI sum-scores at  $t_2$  was higher paternal age (Table 5).

**Table 3** Associations between PTSD/depressive symptoms and demographic, obstetric and psychiatric characteristics for partners of patients participating at  $t_2$  ( $n = 37$ )

	PTSD symptoms	Depressive symptoms
	<i>p</i>	<i>p</i>
<i>Demographic and obstetric variables</i>		
Higher/lower education (partners)	0.245	0.045*
Primipara	0.585	0.791
Cesarean section	0.926	0.652
Infant death	0.016*	0.011*
<i>Psychiatric history (partners of patients)</i>		
PTSD symptoms in history	0.232	0.089
Depressive symptoms in history	0.226	0.199
<i>Psychiatric history (female patients)</i>		
PTSD symptoms in history	0.494	0.888
Depressive symptoms in history	0.133	0.515

Mann–Whitney  $U$  tests: comparison between those with and without the characteristic

\* Significant at  $p = 0.05$  level

#### Discussion

Considering that women with PE and PPROM are more prone to developing PTSD than women with uncomplicated pregnancies [30], the aim of this study was to investigate whether this difference was also found in their partners. We found no significant differences between partners of patients and partners of controls. On the other hand, symptoms of PTSD and depression in men and women often co-occurred at 6 weeks postpartum, which adds to the emerging evidence that fathers should not be overlooked when it comes to the psychological impact of pregnancy and childbirth.

**Table 4** Stepwise hierarchical multiple regression analysis of PTSD symptoms in partners of patients at  $t_2$  ( $n = 37$ )

	Adj. $R^2$	$\Delta R^2$	Beta	Sig.
Model 1: Factors known at $t_1$	0.533	0.553		
Depressive symptoms at $t_1$ (partners)			0.338	0.017*
PTSD symptoms at $t_1$ (partners)			0.289	0.030*
PTSD symptoms at $t_1$ (patients)			0.208	0.104
Paternal age			0.343	0.009**

PSS-SR sum-scores were logarithmically transformed ( $^{10}\log(\text{sum-score} + 1)$ )

$R^2$  explained variance

\* Significant at  $p = 0.05$  level\*\* Significant at  $p = 0.01$  level

**Table 5** Stepwise hierarchical multiple regression analysis of depressive symptoms in partners of patients at  $t_2$  ( $n = 37$ )

	Adj. $R^2$	$\Delta R^2$	Beta	Sig.
Model 2: factors known at $t_1$ and $t_2$	0.643			
<i>Step 1: factors known at <math>t_1</math></i>		0.546		
Depressive symptoms at $t_1$ (partners)			0.252	0.061
PTSD symptoms at $t_1$ (partners)			0.171	0.155
Education (lower/higher)			0.166	0.147
Paternal age			0.253	0.034*
<i>Step 2: factors known at <math>t_2</math></i>		0.097		
Gestational age at delivery			−0.015	0.908
Perinatal infant death			0.256	0.053
Depressive symptoms at $t_2$ (patients)			0.221	0.134

\*  $p < 0.05$ BDI/II sum-scores were logarithmically transformed ( $^{10}\log(\text{sum-score} + 1)$ ). Final step is shown $R^2$  explained variance

Strengths of the study include its prospective longitudinal design, a population that has not often been researched (partners of women with pregnancy complications), and the fact that a representative group of males was willing to participate at  $t_1$ . Differences between partners of patients and partners of controls (Table 1) were in part as expected, as more cesarean sections and a lower gestational age were found in the patient group. However, partners of controls were on average older and higher educated than partners of patients. Partners of controls also more often indicated current psychiatric treatment than partners of patients (0/37 vs. 5/29;  $p = 0.013$ ). This discrepancy may either be due to a higher prevalence of mental health problems in this group, or fewer (personal or financial) barriers in seeking treatment. While we cannot say with certainty, the fact that partners of patients and partners of controls groups report a similar percentage of a history of depression and PTSD is indicative for a difference in treatment-seeking behavior. In all cases of current treatment, men already received treatment prior to the birth of their child for a range of indications including depression, OCD and psychosis. Contrary to expectations [47], psychiatric history was not strongly associated with symptoms of depression or PTSD postpartum in this study. Interestingly, older fathers reported significantly more symptoms of depression and PTSD at  $t_2$  as shown in the SMRA, which is a finding that cannot easily be explained based on previous research and therefore may warrant additional investigation.

Unfortunately, the sample of partners was fairly small ( $n = 85$  at  $t_1$  and  $n = 66$  at  $t_2$ ), and partners of patients

who dropped out of the study after  $t_1$  had more PTSD symptoms (on average) than partners of patients who participated during both time points. Both factors may at least partially explain why no differences were found between partners of patients and partners of controls in prevalence rates and sum-scores of PTSD and depression, and they could possibly have resulted in an underestimation of prevalence rates at  $t_2$ . On the other hand, one could also argue that the drop-out of those with more symptoms at  $t_1$  means that symptoms at  $t_2$  are not merely the result of pre-existing psychopathology. One may hypothesize that, related to “avoidance” as one of the symptom categories of a PTSD diagnosis, the men with PTSD at  $t_1$  declined further participation in the study because reflecting on the birth of their child and the early postpartum period was too confronting for them. Interestingly enough, both for PTSD and depression, prevalence rates are not significantly higher (or even lower) postpartum than during pregnancy. This too may be an effect of selective drop-out, and it is also important to note that the  $t_1$  findings should not be seen as baseline measurements, as female patients and their partners were likely to be already stressed due to the hospitalization and imminent preterm birth. A larger study may reveal whether the trend observed in this study (more PTSD symptoms in partners of patients than in partners of controls) is found significant with a higher number of participating patients and partners. One may also consider to include baseline measurements and a longer follow-up, as we know from the literature that women may also develop PTSD later than 6 weeks postpartum, and the highest incidence of male postpartum depression seems to be 3–6 months postpartum [15].

The prevalence of PTSD in partners of patients was found to be 6 % at  $t_1$  and 3 % at  $t_2$ , and 0 % among partners of controls both in pregnancy and postpartum. Other studies of postpartum PTSD in men found prevalence rates varying from 0 to 5 % [10, 19, 21]. In our current study, the prevalence of depression among fathers was 4 % in pregnancy and 5 % postpartum, which is lower than the 10 % recently estimated in a large meta-analysis [15]. While this may have to do with our population, it could also be due to our strict adherence to the cut-off value listed in the BDI-II manual (sum-score  $\geq 20$ ) for moderate or severe depression [33]. If we would have also included mild depression (cut-off value of 10) as many previous studies did [13, 48–50], the prevalence of depression in men would be 33 % (partners of patients) and 12 % (partners of controls) in pregnancy and 14 % (partners of patients) and 7 % (partners of controls) postpartum. While the benefits of the BDI have previously been mentioned, one may also consider using a questionnaire that has been specifically designed for the pregnancy and postpartum period, such as the Edinburgh Postnatal



Depression Scale (EPDS) [51]. Even though the EPDS does not include all DSM-IV criteria, it is frequently used and has also been validated for males [52].

The lower prevalence rates of PTSD and depression in men than in women found in this study are in accordance with some studies, but not in line with some other studies that found similar rates [10–13, 19, 21]. Intuitively, one may assume that women will experience more symptoms, as (a) the lifetime prevalence rates of PTSD and depression are higher in women than in men [53, 54]; (b) women are 2.3 times more likely to develop PTSD following a traumatic event than men [55]; (c) postpartum depression in men may develop following the onset of depression in women [52]; (d) women have actually experienced pregnancy, labor (pain) and obstetric interventions, while men have merely witnessed, and therefore effects of a different magnitude may be found. The association we found between symptoms of depression and PTSD is well known from literature [47, 56]. Furthermore, the strong within-couple correlation of PTSD and depression symptom severity that was observed postpartum is in line with the findings of previous research that men's and women's responses after childbirth are strongly interlinked in the case of PTSD [14], and 24–50 % of the partners of women with postpartum depression also get postpartum depression [16].

Instead of solely focussing on the new mother, these findings call for a system-oriented approach, evaluating the well being of woman and partner. For future studies we would therefore recommend to always include fathers, and consider the dyad rather than individuals, as partners' symptoms of PTSD and depression postpartum are strongly associated. Early identification and intervention could possibly prevent families from entering a downward spiral, with potentially adverse consequences for the partner relationship and parent–infant bonding, and avoidance of future pregnancies [57]. In summary, this study is one of the first to provide data on PTSD and depression in partners of women with severe pregnancy complications. Contrary to expectations, no differences were found in the occurrence of symptoms of PTSD and depression between partners of patients and partners of controls. Higher paternal age was associated with more symptoms of PTSD and depression in partners of patients. In both groups, we observed significant overlap between symptoms of PTSD and depression, as well as between partners.

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